

## CLAIMS

1. A conductive composition comprising a  $\pi$ -conjugated conductive polymer and a cyano group-containing polymer compound, which is a copolymer of a cyano group-containing monomer and a vinyl group-containing monomer.
2. The conductive composition according to claim 1, further comprising a dopant.
3. The conductive composition according to claim 1, wherein the cyano group-containing monomer is at least one of acrylonitrile and methacrylonitrile.
4. The conductive composition according to claim 1, wherein the vinyl group-containing monomer is at least one selected from the group consisting of vinyl halide compounds, aromatic vinyl compounds, heterocyclic vinyl compounds, aliphatic vinyl compounds, acrylic compounds, diene compounds and maleimide compounds.
5. The conductive composition according to claim 1, wherein the  $\pi$ -conjugated conductive polymer comprises at least one selected from the group consisting of polypyrrole, polythiophene, poly N-methylpyrrole, poly 3-methylthiophene

and poly 3-methoxythiophene.

6. The conductive composition according to claim 1, wherein a copolymerization molar ratio of the cyano group-containing monomer to the vinyl group-containing monomer in the cyano group-containing polymer compound is from 99:1 to 10:90.

7. The conductive composition according to claim 1, wherein a mass ratio of the cyano group-containing polymer compound to the  $\pi$ -conjugated conductive polymer is from 5:95 to 99:1.

8. A conductive coating material comprising the conductive composition according to claim 1 and an organic solvent, the conductive composition being dissolved in the organic solvent.

9. A conductive resin comprising the conductive composition according to claim 1 and an insulating resin, the conductive composition being mixed with the insulating resin.

10. The conductive resin according to claim 9, wherein a difference in SP value between the cyano group-containing polymer compound and the insulating resin is 0 or more and 2 or less.

11. A conductive composition comprising a cyano group-containing polymer compound, a  $\pi$ -conjugated conductive polymer, and a curing agent capable of reacting with a cyano group.

12. The conductive composition according to claim 11, wherein the cyano group-containing polymer compound is a copolymer of the cyano group-containing monomer and the vinyl group-containing monomer.

13. A conductive composition comprising a  $\pi$ -conjugated conductive polymer, a cyano group-containing polymer compound which is a copolymer of a cyano group-containing monomer and a vinyl group-containing monomer having a functional group, and a curing agent capable of reacting at least one of a cyano group and the functional group.

14. The conductive composition according to 13, wherein the functional group is at least one selected from the group consisting of sulfo group, carboxyl group, hydroxyl group, epoxy group and amino group.

15. The conductive composition according to 12 or 13, wherein the cyano group-containing monomer is at least one of

acrylonitrile and methacrylonitrile.

16. The conductive composition according to 11 or 13, further comprising a dopant.

17. The conductive composition according to 11 or 13, wherein the  $\pi$ -conjugated conductive polymer is at least one selected from the group consisting of polypyrrole, polythiophene, poly N-methylpyrrole, poly 3-methylthiophene and poly 3-methoxythiophene.

18. A conductive coating material comprising the conductive composition according to claim 11 or 13 and an organic solvent, the conductive composition being dissolved in the organic solvent.

19. A conductive resin comprising the conductive composition according to claim 11 or 13 and an insulating resin, the conductive composition being mixed with the insulating resin.

20. The conductive resin according to claim 19, wherein a difference in SP value between the cyano group-containing polymer compound and the insulating resin is 0 or more and 2 or less.

21. A conductive composition comprising, at least, a conjugated conductive polymer, at least one of a polyanion and an electron-withdrawing functional group-containing polymer, and a cluster derivative in which an anion group is introduced into carbon atoms of a cluster molecule which contains carbon as a main component.

22. The conductive composition according to claim 1, wherein the conjugated conductive polymer is a polymer which comprises one or more conjugated five-membered heterocyclic compounds.

23. The conductive composition according to claim 21, wherein the cluster derivative is a derivative prepared by introducing an anion group into at least one of carbon cluster molecule which is selected from cage-like carbon cluster molecule, spherical carbon cluster molecule and tubular carbon cluster molecule.

24. The conductive composition according to claim 23, wherein the cluster derivative is prepared by introducing the anion group into the cage-like carbon cluster molecule.

25. The conductive composition according to claim 21,

wherein the length of a major axis of the cluster derivative has is 100 nm or less.

26. The conductive composition according to claim 21, wherein the anion group is at least one selected from  $-O-SO_3X$ ,  $-COOX$  and  $-SO_3X$ , in which X represents a hydrogen atom or an alkali metal atom in the respective formulas.

27. The conductive composition according to claim 21, wherein two or more anion groups are introduced per one cluster molecule.

28. The conductive composition according to claim 21, wherein the polyanion is any one of polyisoprenesulfonic acid and an isoprenesulfonic acid copolymer.

29. The conductive composition according to claim 21, wherein the electron-withdrawing functional group-containing polymer is at least one selected from the group consisting of polyacrylonitrile, polyparabanic acid and polyvinylidene fluoride.

30. The conductive composition according to claim 21, further comprising a resin component other than the polymer contained in the conductive composition.

31. A conductive composition comprising a polyanion (A), in which an anion group is bonded with a main chain via an ester group, and a conjugated conductive polymer (B).

32. The conductive composition according to claim 31, wherein, in the polyanion (A), the anion group is bonded with the ester group via at least one of an aromatic ring and an alkylene group which has a substituent optionally.

33. The conductive composition according to claim 31, wherein the anion group is a sulfonic acid group.

34. The conductive composition according to claim 31, further comprising an anion compound (E) other than the polyanion (A).

35. The conductive composition according to claim 31, which is obtained by chemical oxidation polymerization of a monomer of the conjugated conductive polymer (B) in the presence of the polyanion (A).

36. A method for preparing the conductive composition according to claim 31, which comprises:

(1) subjecting a monomer of a conjugated conductive

polymer (B) dissolved or dispersed in a solvent to chemical oxidation polymerization in the presence of a polyanion (A), and

(2) removing free ions by an ultrafiltration method after the above step.

37. The method for preparing the conductive composition according to claim 36, further comprising the step of: (3) adding a proton-containing solution.

38. A conductive composition comprising a conductive filler and a conductive mixture of a cyano group-containing polymer compound and a  $\pi$ -conjugated conductive polymer.

39. The conductive composition according to claim 38, wherein the surface of the conductive filler is coated with the  $\pi$ -conjugated conductive polymer.

40. The conductive composition according to claim 38, further comprising a dopant.

41. The conductive composition according to claim 38, wherein the conductive filler has at least one of a sulfo group and a carboxyl group on the surface.



42. The conductive composition according to claim 38, wherein a mass ratio of the cyano group-containing polymer compound to the  $\pi$ -conjugated conductive polymer is from 5:95 to 99:1.

43. The conductive composition according to claim 38, wherein a mass ratio of the conductive mixture to the conductive filler is from 50:50 to 99.9:0.1.

44. A method for preparing a conductive composition, which comprises polymerizing a precursor monomer of a  $\pi$ -conjugated conductive polymer in the presence of a cyano group-containing polymer compound to give a conductive mixture, and mixing the conductive mixture with a conductive filler.

45. A conductive coating material comprising the conductive composition according to claim 38, and water or an organic solvent.

46. A capacitor comprising an anode made of a porous material of a valve metal; a dielectric layer made of an oxide film of the valve metal, which is adjacent to the anode; and a cathode made of the conductive composition according to claim 38.

47. A method for producing a capacitor, which comprises forming, on an anode made of a porous material of a valve metal, a dielectric layer made of an oxide film of the valve metal; applying the conductive coating material according to claim 45 onto the dielectric layer; and drying the conductive coating material to form a cathode made of a conductive composition on the surface of the dielectric layer.

48. A photoelectric transducer having a laminated configuration in which a hole transporting polymer electrolyte film is formed between an n-type semiconductor electrode, which contains a dye absorbed on the surface thereof, and an electronic conductive electrode, wherein

the hole transporting polymer electrolyte film contains a conjugated conductive polymer and at least one of a polyanion and an electron-withdrawing functional group-containing polymer.

49. The photoelectric transducer according to claim 48, wherein the hole transporting polymer electrolyte film contains an inorganic p-type semiconductor.

50. The photoelectric transducer according to claim 48, wherein the hole transporting polymer electrolyte film contains a fibrous conductor.

51. The photoelectric transducer according to claim 50, wherein the fibrous conductor is a material having a sulfonic acid group.

52. The photoelectric transducer according to claim 48, wherein the hole transporting polymer electrolyte film is a coating film formed on the n-type semiconductor electrode.

53. A method for producing a photoelectric transducer, which comprises:

dispersing or dissolving a conjugated conductive polymer and at least one of a polyanion and an electron-withdrawing functional group-containing polymer in a solvent;

applying the resulting solution onto an n-type semiconductor and removing the solvent to form a coating film; and

forming an electronic conductive electrode on the coating film.

54. A conductive composition comprising a conjugated conductive polymer and a polyanion: wherein

the conjugated conductive polymer is at least one selected from the group consisting of polypyrroles, polythiophenes and polyanilines, and

the polyanion is at least one selected from the group consisting of substituted or unsubstituted polyalkylene, substituted or unsubstituted polyalkenylene, substituted or unsubstituted polyimide, substituted or unsubstituted polyamide and substituted or unsubstituted polyester, and the polyanion comprises a constituent unit having an anion group and a constituent unit having no anion group, and also satisfies the relation:  $m/n \leq 1$  where m represents the number of the constituent unit having an anion group and n represents the number of the constituent unit having no anion group.

55. The conductive composition according to claim 54, wherein the polyanion, which comprises the constituent unit having an anion group and the constituent unit having no anion group, has a side chain, and the anion group is bonded with the side chain.

56. The conductive composition according to claim 54, wherein the polyanion, which comprises the constituent unit having an anion group and the constituent unit having no anion group, is a polymer which includes a substituted or unsubstituted alkenylene as a constituent unit.

57. The conductive composition according to claim 56,

wherein the substituted or unsubstituted alkenylene is a substituted or unsubstituted butenylene.

58. The conductive composition according to claim 54, wherein the anion group is at least one of a sulfonic acid group and a carboxylic acid group.

59. The conductive composition according to claim 54, wherein the mol number of the anion group of the polyanion is less than that of the dopant of the conjugated conductive polymer.

60. The conductive composition according to claim 54, further comprising an anion other than the polyanion.

61. The conductive composition according to claim 60, wherein the anion other than the polyanion is an organic sulfonic acid.

62. A method for preparing the conductive composition according to claim 54, which comprises subjecting a monomer of the conjugated conductive polymer to oxidation polymerization in the presence of the polyanion.

63. A method for preparing the conductive composition

according to claim 54, which comprises subjecting a monomer of the conjugated conductive polymer to oxidation polymerization in the presence of the polyanion and the organic sulfonic acid.